MATERIALS BUREAU

TECHNICAL REPORT 03-01

Evaluation of Bridge Deck Overlays

November 2003

M.A.P. CODE 7.42-6-03-01

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

TECHNICAL REPORT 03-1

EVALUATION OF
BRIDGE DECK OVERLAYS

Final Report

Prepared by

David Z. Graves

NOVEMBER, 2003

MATERIALS BUREAU
JOHN E. RONDINARO, DIRECTOR

NEW YORK STATE DEPARTMENT OF TRANSPORTATION
1220 WASHINGTON AVENUE, ALBANY, NY 12232

M.A.P. CODE 7.42-6-03-1

ABSTRACT

The New York State Department of Transportation (NYSDOT) discovered that many bridge decks were deteriorating prematurely in the early 1970's. Many of these decks were around 10 years old. NYSDOT decided to try and extend the life of these bridge decks because the majority of the deterioration was occurring from the top reinforcing mat up while the lower deck slab was in good condition. The deterioration was caused by the infiltration of corrosion inducing chlorides to the top reinforcing mat. NYSDOT choose to remove the chloride contaminated and deteriorating concrete and replace it with an overlay material. This report summarizes the performance of the three bridge deck overlay materials (high density concrete, latex modified concrete, and microsilica concrete) used. These materials are less permeable to the intrusion of chlorides than the concrete that was replaced. The tests used to evaluate the performance of the overlays were half cell potentials, distress surveys (delaminations), and chloride sampling. The results of the study show that the goal of extending the service life of the bridge decks for 10 to 15 years was met.

NYSDOT
Library
50 Wolf Road, POD 34
Albany, New York 12232

CONTENTS

INTRODUCTION 1

MIX DESIGNS 1

CONSTRUCTION PRACTICES 2

LOCATION AND GENERAL CONDITIONS OF EXPOSURE ON BRIDGE DECKS 2

EVALUATION METHODS 2

CONCLUSIONS 4

ACKNOWLEDGEMENTS 23

INTRODUCTION

In the early 1970's The New York State Department of Transportation (NYSDOT) realized that bridge decks built with uncoated reinforcing bars and two inches of cover to the top reinforcing bar mat were deteriorating. The surface of decks were delaminating and spalling due to corrosion of the top reinforcing mat. Chlorides from deicing salts were penetrating down to the uncoated reinforcing causing accelerated corrosion and subsequent delamination and spalling. Many of these bridge decks were originally built during the major portion of construction of the interstate system.

The portion of the bridge deck below the top reinforcing mat was in generally good condition. NYSDOT decided that if the chloride contaminated concrete could be removed and replaced with fresh concrete that had a higher resistance to permeability then the life of these bridge decks could be extended by 10 to 15 years.

High density or low slump concrete and latex modified concrete were the two materials originally chosen for overlays. Microsilica concrete was later added to the study when it was developed in the mid 1980's. There is a correlation that the Coefficient of Permeability increases with increased water-cement ratio's; hence, the High density concrete exhibits a higher impermeability due to the lower water to cement ratio of 0.327 compared to conventional concrete, that typically is in the .40-0.50 water to cement ratio range. The lower water to cement ratio results in the hydrated cement particles being closer together and therefore more densely packed together. Latex modified concrete has higher impermeability due to a system of coalesced latex particles. Microsilica concrete has higher impermeability due to more hydration product and a denser concrete. This is caused by the presence of microsilica or silica fume particles in the concrete. (Silica fume is also particularly effective in decreasing the porosity of the transition zone between paste and aggregate.)

In order to implement the plan to overlay bridges NYSDOT agreed with the Federal Highway Authority to study the performance of the overlays and report the findings. This is a final report of those findings.

MIX DESIGNS

High Density Concrete
Cement - 826 lb/c.y.
Fine Aggregate (% Total Aggregate by Volume) - 50%
Air Content - 5.0 to 8.0%
Water to Cement Ratio - 0.327
Slump - 0.5 to 1 inches

Latex Modified Concrete
Cement - 658 lb/c.y.
Fine Aggregate (% Total Aggregate by Volume) - 60%
Latex Admixture - 24.5 gal/c.y.
Air Content - 6.5% max
Water - 17.5 gal/c.y.
Slump - 2.0 to 6.0 inches

Microsilica Concrete
Cement - 680 lb/c.y.
Microsilica - 85 lb/c.y.
Fine Aggregate (% Total Aggregate by Volume) - 53%
Air Content - 5.0 to 8.0%
Water to Cement Ratio - 0.40
Slump - 5 to 8 inches

CONSTRUCTION PRACTICES

Deteriorated bridge decks were repaired in the following manner. First the bridge deck concrete was milled down to the top mat of reinforcing. Areas that were either delaminated below the reinforcing or determined to have a high potential for corrosion through potential testing were removed. Removal was done using chipping hammers to at least 1" below the top mat of reinforcing bars or down to sound concrete.

Concrete was then blast cleaned to remove any loose material and to clean the surface of the concrete. The concrete surface was wetted just prior to the application of a bonding grout. The bonding grout, consisting of a 1:1 cement to sand mixture, was applied to the surface of the concrete and then the overlay was placed. A finishing machine was used to finish the surface of the concrete. The concrete was then textured with a tining rack.

The deck was then cured. High density concrete was cured with wet burlap. Latex modified concrete was allowed to air dry to cure. Microsilica concrete was cured with wet burlap.

LOCATION AND GENERAL CONDITIONS OF EXPOSURE ON BRIDGE DECKS

Figure 1 shows the location of the bridge decks evaluated.

Current deicing policy is for an initial application of 225 lbs/lane mile of sodium chloride with a follow up application of 115 lbs/lane mile. Bridges, however, receive significantly higher applications over their lifetimes than the adjacent sections of roadway. This is due to the fear applicators have of bridges freezing. Applicators often increase application rates up to perhaps 500 lbs/lane mile on bridge decks. Applicators will also sometimes randomly apply salt to bridges they cross that are not on their assigned route.

EVALUATION METHODS

The work plan for this project called for taking at least potential readings and depending on if obvious distress was present delamination surveys and chloride sampling. In general, potential readings were taken every year from the construction of decks until 1988. This data was reported annually to the FHWA in interim reports. Data was collected intermittently until the final surveys as listed on the tables.

This report is an attempt to summarize the final condition of the overlays.

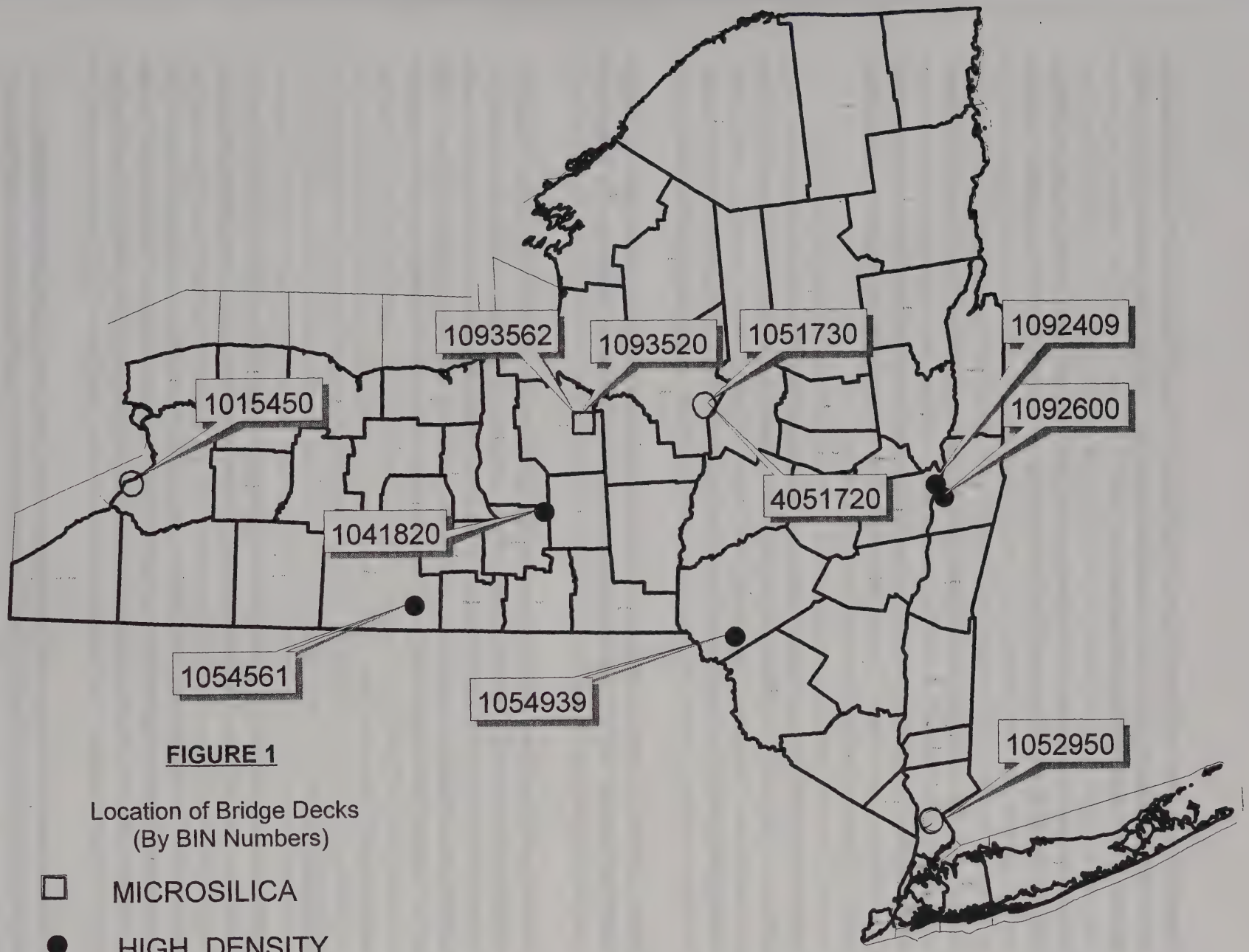

FIGURE 1

Location of Bridge Decks
(By BIN Numbers)

□ MICROSILICA

● HIGH DENSITY

○ LATEX MODIFIED CONCRETE

Potential Survey - Potential surveys entail the measuring of electrical potential which exists between a metal and its ions in solution relative to something of known or assigned potential. In this case the reference was a copper-copper sulfate half cell.

Potential surveys were conducted in accordance with the NYSDOT Field Survey Manual for Bridge Deck Overlay Projects. The ground for the surveys was permanently installed and tested with each use.

Potential readings are accomplished by placing a lead onto a ground and into the negative side of a voltmeter. Another lead is put into the plus side of the voltmeter and attached to the copper-copper sulfate half cell. The tip of the half cell is then placed on the surface of the concrete and the voltage at that location can be read. This method is described in much greater detail in the field survey manual. The entire deck was surveyed on a five foot grid.

As indicated in the tables potential readings of less than 0.20 indicate no corrosion. Potential readings of 0.20 to 0.34 indicate light to moderate corrosion. Readings of 0.35 to 0.50 indicate moderate to heavy corrosion and readings of 0.51 to 0.75 indicate heavy corrosion. While these limits are established the rule is that the higher the number the more indication there is of corrosion. The closer a reading is to another range the harder it is to place that reading solidly in either range.

Distress survey - The decks were inspected for delaminations by sounding the entire surface of the deck with a hammer. When a hollow sound was heard this indicated a delamination. The areas of delamination were then recorded.

Chloride sampling- Samples of concrete powder for chloride content testing were obtained by drilling into the deck with a rotary impact drill in one location randomly chosen on the deck. In order to obtain samples down to a depth of three inches a pachometer was used to locate and avoid reinforcing bars. Samples of concrete powder were taken at the one, two, and three inch levels. The powder samples were then brought to the laboratory and tested for total chloride content in accordance with (NYSDOT test method 502-5C) ASTM T260 except under 10.1.1 Standard Solution Ag^{+} - 2000 ppm.

CONCLUSIONS

The final results of the surveys show that the original goal of the overlay program was met. The goal of extending the useful life of bridge decks 10 to 15 years prior to permanent reconstruction was met. The average life of the latex modified concrete overlays at the end of the study was 18 years and the average life of the high density concrete overlays at the end of the study was 17 years. The microsilica concrete overlays were still too new (7 years) at the end of the study to draw conclusions. It is assumed, however, that the improved properties of the microsilica concrete will lead to equal or improved performance of the overlays compared to latex modified or high density concrete.

Seven year potential data results for latex and high density decks was compiled for comparison with the microsilica data in Table 23. This data shows that the microsilica overlays were performing better than the latex or high density overlays of the same age.

Summary tables are included in this report for each deck studied. The overlay survey results for high density concrete are in Tables 1 thru 5, for latex modified concrete in Tables 6 thru 10, and for microsilica concrete in Tables 11 and 12. There are also summary tables for distress, chloride levels, and potentials. The summary tables for overlay distress (delamination) surveys include Table 13 for high density, Table 14 for latex modified concrete, and Table 15 for microsilica concrete. The summary tables for chloride levels include Table 16 for high density concrete, Table 17 for latex modified concrete, and Table 18 for microsilica concrete. The summary tables for overlay potential survey results include Table 19 for high density, Table 20 for latex modified concrete, Table 21 for microsilica concrete, and Table 22 for comparison of potential survey results.

There are many variables that have influenced the results of this study which were impossible to quantify but nonetheless exist. Some of these variables include:

-problems with original construction such as not removing unsound concrete, improper overlay construction such as letting bonding grout dry out prior to placing the overlay, or not cleaning the surface of the substrate prior to placing the overlay

-The occurrence of corrosion in localized areas such as at the bridge joints and longitudinal joint between lanes in stage construction.

For example, the construction problems of allowing the bonding grout to dry out or not cleaning the surface probably caused or contributed to the large delamination (30.8%) of the high density Washington Ave bridge over I90 as compared to the other high density decks (see Table 13).

A review of Tables 16, 17, and 18 indicates a high chloride content at the 2 and 3 inch levels for I481 north bound over 290 in Table 18 as compared to most older overlays. These numbers could be influenced by not removing the older concrete under the 1.5 inch depth compared to other overlays which might have had the concrete removed. The 1 inch depth values are the most reliable for comparison between overlays because this should be only overlay material at this depth.

The significance of studying high density concrete and latex modified concrete overlays was diminished with the advent of microsilica concrete overlays. While the high density concrete and latex modified concrete performed well the choice of contractors over time became microsilica concrete. NYSDOT had specifications which included all three types of overlay materials as options. Today, NYSDOT specifies only the use of microsilica concrete due to poor workability and significant cost differences in high density and latex modified concrete.

Mobile concrete mixers are required for the production of high density concrete. Field stockpiles and calibration are just two of the draw backs to mobile concrete mixers. High density concrete also required the use of a very large and heavy finishing machine that was expensive, difficult to handle, and hard to set up.

Mobile concrete mixers were also required for the production of latex modified concrete. The use of a conventional roller screed finishing machine however was a plus for latex modified concrete.

Microsilica concrete has the advantage of being batched from a ready mix concrete plant and transported in transit mixers. Microsilica concrete can also be finished with a conventional roller screed finishing machine.

There have been changes made to the overlay program in NYSDOT to enhance the performance of overlays. These changes included modifying the longitudinal joint between lanes during stage construction to prevent the intrusion of water and chlorides into the deck. This was done by cutting approximately half way through the newly constructed overlay and then chipping away from the newly constructed overlay at a 45 degree angle. This increased the surface area the subsequent overlay had to bond to and eliminated the direct path for water and chlorides.

Other changes have been made by NYSDOT to improve the performance of overlays since the construction of these study overlays. One change was more specific guidance in the amount of deck surface and the depth of concrete to remove. This was done to eliminate islands and peninsulas of marginal concrete from remaining depending on the results of initial condition surveys of a deck. Another change was to fill in the areas where concrete was removed around the reinforcing bars to create an even surface prior to the overlay.

Table 1

Rte. 378 Over Rte. 32 (Broadway in Menands

BIN: 1092409

Region: 1

Contract: D95257 PIN: 1045.03.321

Date of Overlay Construction: 1978

Date of Original Construction: 1971

Overlay Material: High Density

Deck Dimensions: 42.5 ft wide by 161 ft long

Date of Last Survey: 10/23/96

Years of Overlay Service: 18

Chlorides in PPM:

Depth (in)	Sample 1	Sample 2	Sample 3	Avg.
1	2747	1213	1677	1879
2	749	0	214	321
3	392	0	36	214

Delaminated Area/Total Area =25.92/6855=0.38%

Potential Survey Results:

Less than 0.20 - No Corrosion	125	43.7%
0.20 to 0.34 Light to Moderate	150	52.4%
0.35 to 0.50 Moderate to Heavy	8	2.8%
0.51 to 0.75 Heavy	3	1.0%
	286	

Table 2

Washington Ave. over I 90

BIN: 1092600

Region: 1

Contract: FISH 67-12 PIN: 1750.79.321

Date of Overlay Construction: 1977

Date of Original Construction: 1967

Overlay Material: High Density

Deck Dimensions: 2 spans 32 ft wide by 100 ft long at a -24° skew

Date of Last Survey: 10/25/96

Years of Overlay Service: 19

Chlorides in PPM:

	Span 1				Span 2		
Depth (in)	Sample 1	Sample 2	Sample 3	Sample 4	Sample 1	Sample 2	Avg.
1	2069	2533	2783	2926	2391	2319	2503
2	1284	2212	678	428	999	642	1041
3	999	1935	285	0	143	0	410

Delaminated Area/Total Area = 729.31+1246.54/6400 = 30.87%

Potential Survey Results:

Less than 0.20 - No Corrosion	102	31.7%
0.20 to 0.34 Light to Moderate	181	56.2%
0.35 to 0.50 Moderate to Heavy	38	11.8%
0.51 to 0.75 Heavy	1	0.3%
	322	

Table 3

Rte 222 Over Fall Creek

BIN: 1041820

Region: 3

Contract: D96122 PIN: 3169.03.101

Date of Overlay Construction: 1979

Date of Original Construction: 1959

Overlay Material: High Density

Deck Dimensions: 29.5 ft wide by 70 ft long

Date of Last Survey: 11/7/96

Years of Overlay Service: 17

Chlorides in PPM:

Depth (in)	Span 1 WB	Span 1 EB	Span 2 WB	Span 2 EB	Avg.
1	3211	2533	2783	2926	2503
2	428	2212	678	428	1041
3	71	1935	285	0	410

Delaminated Area/Total Area = 9.8/4130 = 0.24%

Potential Survey Results:

Less than 0.20 - No Corrosion	109	47.6%
0.20 to 0.34 Light to Moderate	59	25.8%
0.35 to 0.50 Moderate to Heavy	48	21.0%
0.51 to 0.75 Heavy	13	5.7%
	229	

Table 4

Rte. 15 SB over Conrail

BIN: 1054561

Region: 6

Contract: D96091 PIN: NA

Date of Overlay Construction: 1979

Date of Original Construction: 1969

Overlay Material: High Density

Deck Dimensions: 39 ft wide by 82 ft long

Date of Last Survey: 10/21/93

Years of Overlay Service: 14

Chlorides (1990) in PPM:

Depth (in)	Span 1	Span 2	Span 3	Avg.
1	785	36	821	547
2	2284	1427	1356	1689
3	178	642	500	440

Delaminated Area/Total Area = 299.66/10042 = 2.98%

Potential Survey Results:

Less than 0.20 - No Corrosion	299	72%
0.20 to 0.34 Light to Moderate	107	25.8%
0.35 to 0.50 Moderate to Heavy	8	1.9%
0.51 to 0.75 Heavy	1	0.2%
	415	

Table 5

Rte. 17 The Horton Viaduct

BIN: 1054939

Region: 9

Contract: D95779 PIN: 9006.66.321

Date of Overlay Construction: 1979

Date of Original Construction: 1966

Overlay Material: High Density

Deck Dimensions: Span 5 - 29.5 ft wide by 106 ft long
Span 22 - 29.5 ft wide by 106 ft long

Date of Last Survey: 11/18/96

Years of Overlay Service: 17

Chlorides in PPM:

	Span 5		Span 22		
Depth (in)	Sample 1	Sample 2	Sample 1	Sample 2	Avg.
1	2605	2926	2819	2355	2676
2	928	535	749	1427	910
3	392	214	0	714	330

Delaminated Area/Total Area = 40.75/6636 = 0.61%

Potential Survey Results:

Less than 0.20 - No Corrosion	220	76.4%
0.20 to 0.34 Light to Moderate	42	14.6%
0.35 to 0.50 Moderate to Heavy	14	4.9%
0.51 to 0.75 Heavy	12	4.2%
	288	

Table 6

Lake St. over I 684

BIN: 1052950

Region: 8

Contract: FISH 65-17 PIN: 8113.05.111

Date of Overlay Construction: 1976

Date of Original Construction: 1966

Overlay Material: Latex Modified Concrete

Deck Dimensions: All spans are at a +43° skew
Span 1 - 28 ft wide by 72 ft long
Span 2 - 28 ft wide by 72 ft long
Span 3 - 28 ft wide by 72 ft long
Span 4 - 28 ft wide by 72 ft long

Date of Last Survey: 11/15/96

Years of Overlay Service: 20

Chlorides in PPM:

	Span 1		Span 2		Span 3		Span 4		
Depth (in)	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2	Avg.
1	1177	1606	1106	1249	1142	1998	1784	2426	1561
2	357	535	1106	999	321	1213	1070	1499	888
3	214	285	714	785	71	517	1142	392	522

Delaminated Area/Total Area = 715.73/9517 = 7.52%

Potential Survey Results:

Less than 0.20 - No Corrosion	202	45%
0.20 to 0.34 Light to Moderate	221	49.2%
0.35 to 0.50 Moderate to Heavy	24	5.3%
0.51 to 0.75 Heavy	2	0.4%
	449	

Table 7

Genesee St. over Barge Canal

BIN: 4051720

Region: 2

Contract: FAC 65-18 PIN: 2750.51.321

Date of Overlay Construction: 1977

Date of Original Construction: 1967

Overlay Material: Latex Modified Concrete

Deck Dimensions: 52 ft wide by 126 ft long

Date of Last Survey: 11/4/96

Years of Overlay Service: 19

Chlorides in PPM:

Depth (in)	Sample 1	Sample 2	Sample 3	Sample 4	Avg.
1	1213	1106	678	1713	1178
2	71	71	0	36	45
3	0	107	0	71	45

Delaminated Area/Total Area = 1074.72/6552 = 16.40%

Potential Survey Results:

Less than 0.20 - No Corrosion	101	36.7%
0.20 to 0.34 Light to Moderate	146	53.1%
0.35 to 0.50 Moderate to Heavy	26	9.5%
0.51 to 0.75 Heavy	2	0.7%
	275	

Table 8

N. Genesee St. over Reall Creek

BIN: 1051730

Region: 2

Contract: D95178 PIN: 2750.51.321

Date of Overlay Construction: 1977

Date of Original Construction: 1967

Overlay Material: Latex Modified Concrete

Deck Dimensions: 52 ft wide by 45 ft long

Date of Last Survey: 11/04/96

Years of Overlay Service: 19

Chlorides in PPM:

Depth (in)	Sample 1	Sample 2	Sample 3	Sample 4	Avg.
1	2105	357	3140	2498	2925
2	250	0	963	642	464
3	107	0	178	607	223

Delaminated Area/Total Area = 453.5/2288 = 19.82%

Potential Survey Results:

Less than 0.20 - No Corrosion	19	17.3%
0.20 to 0.34 Light to Moderate	31	28.2%
0.35 to 0.50 Moderate to Heavy	31	28.2%
0.51 to 0.75 Heavy	29	26.4%
	110	

Table 9

Rte. 20 over 18 Mile Creek - Span 7

BIN: 1015450

Region: 5

Contract: D95157 PIN: 5111.22.321

Date of Overlay Construction: 1976

Date of Original Construction: 1930

Overlay Material: Latex Modified Concrete

Deck Dimensions: 56 ft wide by 40 ft long (middle 16 ft covered with white topping)

Date of Last Survey: 10/20/93

Years of Overlay Service: 17

Chlorides in PPM:

Depth (in)	Sample 1	Sample 2	Avg.
1	2105	464	1285
2	285	71	178
3	107	71	89

Delaminated Area/Total Area = 347.42/1680 = 20.68%

Potential Survey Results:

Less than 0.20 - No Corrosion	1	1.2%
0.20 to 0.34 Light to Moderate	34	40.5%
0.35 to 0.50 Moderate to Heavy	32	38.1%
0.51 to 0.75 Heavy	17	20.2%
	84	

Table 10

Rte. 20 over 18 Mile Creek - Span 5

BIN: 1015450

Region: 5

Contract: D95157 PIN: 5111.22.321

Date of Overlay Construction: 1976

Date of Original Construction: 1930

Overlay Material: Latex Modified Concrete

Deck Dimensions: 56 ft wide by 124 ft long (middle 16 ft covered with white topping)

Date of Last Survey: 10/20/93

Years of Overlay Service: 17

Chlorides in PPM:

Depth (in)	Sample 1	Sample 2	Avg.
1	1606	2533	2070
2	321	357	339
3	464	321	393

Delaminated Area/Total Area = 1385.95/5208 = 26.61%

Potential Survey Results:

Less than 0.20 - No Corrosion	16	6.2%
0.20 to 0.34 Light to Moderate	139	53.7%
0.35 to 0.50 Moderate to Heavy	83	32.0%
0.51 to 0.75 Heavy	21	8.1%
	259	

Table 11

Rte. I 481 NB over Rte. 290

BIN: 1093562

Region: 3

Contract: D251436 PIN: 3056.02.311

Date of Overlay Construction: 1986

Date of Original Construction: 1972

Overlay Material: Microsilica Concrete

Deck Dimensions: 51 ft wide by 115 ft long

Date of Last Survey: 10/28/93

Years of Overlay Service: 7

Chlorides in PPM:

Depth (in)	Sample 1	Sample 2	Sample 3	Avg.
1	71	214	143	143
2	36	71	3140	1082
3	250	178	3247	1225

Delaminated Area/Total Area = 171.5/5865 = 2.92%

Potential Survey Results:

Less than 0.20 - No Corrosion	112	73.7%
0.20 to 0.34 Light to Moderate	36	23.7%
0.35 to 0.50 Moderate to Heavy	4	2.6%
0.51 to 0.75 Heavy	0	0%
	152	

Table 12

I 690 SB Ramp over I 481 SB

BIN: 1093520

Region: 3

Contract: D251436 PIN: 3056.02.321

Date of Overlay Construction: 1986

Date of Original Construction: 1972

Overlay Material: Microsilica Concrete

Deck Dimensions: 30 ft wide by (128 ft (left side) and 121 ft (right side)) long

Date of Last Survey: 10/28/93

Years of Overlay Service: 7

Chlorides in PPM: (1991)

Depth (in)	Sample 1	Sample 2	Avg.
1	214	143	179
2	178	143	161
3	250	214	232

Delaminated Area/Total Area = 13/3735 = 0.35% - This was from a survey in 1989

Potential Survey Results:

Less than 0.20 - No Corrosion	93	58.9%
0.20 to 0.34 Light to Moderate	61	38.6%
0.35 to 0.50 Moderate to Heavy	3	1.9%
0.51 to 0.75 Heavy	1	0.6%
	158	

DELAMINATION SUMMARY (%)

Table 13

HIGH DENSITY CONCRETE

378 over 32	Wash Ave over I 90	222 over Fall Creek	15 SB over Conrail	17 Horton Viaduct
0.38	30.87	0.24	2.98	0.61

Unweighted Average - 7.02
True Average - 6.90

Table 14

LATEX MODIFIED CONCRETE

Gen. St. over Barge Canal	N. Gen. St. over Reall Creek	Span 7 20 over 18 Mile Creek	Span 5 20 over 18 Mile Creek	Lake St. over I 684
16.4	19.82	20.68	26.61	7.52

Unweighted Average - 18.21
True Average - 15.75

Table 15

MICROSILICA CONCRETE

I 481 NB over 290	I 690 Ramp over I 481 SB
2.92	0.35

Unweighted Average - 1.64
True Average - 1.92

AVERAGE CHLORIDE TEST RESULTS (PPM)

Table 16

HIGH DENSITY CONCRETE

	378 over 32	Wash Ave over I 90	222 over Fall Creek	15 SB over Conrail	17 Horton Viaduct	Avg.
Depth (in)						
1	1879	2503	3033	547	2676	2128
2	321	1041	856	1689	910	963
3	214	410	196	440	330	318

Table 17

LATEX MODIFIED CONCRETE

	Gen. St. over Barge Canal	N. Gen. St. over Reall Creek	Span 7 20 over 18 Mile Creek	Span 5 20 over 18 Mile Creek	Lake St. over I 684	Avg.
Depth (in)						
1	1178	2025	1285	2070	1561	1624
2	45	464	178	339	888	383
3	45	223	89	393	522	254

Table 18

MICROSILICA CONCRETE

	I 481 NB over 290	I 690 Ramp over I 481 SB	Avg.
Depth (in)			
1	143	179	161
2	1082	161	622
3	1225	232	729

POTENTIAL SURVEY SUMMARY (%)

Table 19
HIGH DENSITY CONCRETE

	378 over 32	Wash Ave over I 90	222 over Fall Creek	15 SB over Conrail	17 Horton Viaduct
Less than 0.20 - no corrosion	43.7	31.7	47.6	72.0	76.4
0.20 to 0.34 light to moderate	52.4	56.2	25.8	25.8	14.6
0.35 to 0.50 moderate to heavy	2.1	11.8	21.0	1.9	4.9
0.51 to 0.75 heavy	1.0	0.3	5.7	0.2	4.2

Table 20
LATEX MODIFIED CONCRETE

	Gen. St. over Barge Canal	N. Gen. St. over Reall Creek	Span 7 20 over 18 Mile Creek	Span 5 20 over 18 Mile Creek	Lake St. over I84
Less than 0.20 - no corrosion	36.7	17.3	1.2	6.2	45.0
0.20 to 0.34 light to moderate	53.1	28.2	40.5	53.7	49.2
0.35 to 0.50 moderate to heavy	9.5	28.2	38.1	32	5.3
0.51 to 0.75 heavy	0.7	26.4	20.2	8.1	0.4

Table 21
MICROSILICA CONCRETE

	I 481 NB over 290	I 690 Ramp over I 481 SB
Less than 0.20 - no corrosion	73.7	58.9
0.20 to 0.34 light to moderate	23.7	38.6
0.35 to 0.50 moderate to heavy	2.6	1.9
0.51 to 0.75 heavy	0	0.6

Table 22
COMPARISON OF POTENTIAL SURVEY RESULTS

	Gen. St. over Barge Canal		N. Gen. St. over Reall Creek		Span 7 20 over 18 Mile Creek	
Avg Life	Latex (5) 18 years		High Density (5) 17 years		Microsilica 7 years	
Less than 0.20 - no corrosion	339	28.8%	855	55.5%	205	66.1%
0.20 to 0.34 light to moderate	571	48.5%	539	35.0%	97	31.3%
0.35 to 0.50 moderate to heavy	196	16.6%	116	7.5%	7	2.3%
0.51 to 0.75 heavy	71	6.0%	30	2.0%	1	0.3%
	1177		1540		310	

This table is provided to give a more realistic comparison of the performance of microsilica overlays to high density and latex. The older high density and latex overlays could not be expected to perform as well as the newer microsilica overlays. Data on 7 year old high density and latex overlays was therefore compiled to compare to the 7 year old data of the microsilica overlays.

Table 23

Potential Data Results
Seven Year Old Overlays

Avg Life	Latex (5) 18 years		High Density (5) 17 years		Microsilica 7 years	
Less than 0.20 - no corrosion	402	34.6%	285	51.2%	205	66.1%
0.20 to 0.34 light to moderate	629	54.1%	254	45.6%	97	31.3%
0.35 to 0.50 moderate to heavy	117	10.1%	18	3.2%	7	2.3%
0.51 to 0.75 heavy	14	1.2%	0	0.0%	1	0.3%
	1162		557		310	

ACKNOWLEDGEMENTS

Many people contributed to the completion of this study. Linda Ross deserves special thanks for her patience in the preparation of this report. Various maintenance crews provided safe and professional maintenance and protection of traffic with a cooperative attitude to facilitate data gathering. A few of those who participated in data gathering over the years included Paul St. John, Patrick Galarza and Donald Streeter. Joseph Micare and Alan Frank helped prepare interim reports.

01574
LRI